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## Pathologists' attitudes to implementing telepathology

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### Summary

If pathologists will benefit so much from using telepathology, why is it taking so long to be introduced? This question has been discussed between experts, but the potential users are rarely asked for their opinions. A questionnaire was sent to the 256 members of the Austrian Society of Pathology; this addressed general aspects of telemedicine, telepathology in frozen-section services and expert consultation, videoconferencing technologies, teleteaching and teletraining. The response rate was 46%. In general, the pathologists thought that telemedicine could become valuable in their daily routine. However, pathologists were most afraid of sampling errors in remote diagnosis and would not readily accept an alternative to the conventional method of looking at a sample. This is only possible using realtime, remotely controlled microscopes. Telepathology systems providing only still images would not be acceptable to most respondents. There was interest in the use of videoconferencing for clinicopathological conferences. Teleteaching and teletraining were seen as welcome additional techniques, but were nevertheless judged unable to replace classical methods of teaching and training.

### Introduction

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Telecommunication devices have long been used to exchange medical data—the first reports date back at least to the turn of the century, for example concerning transmission of electrocardiograms<sup>1</sup>. For an image-based subspecialty like pathology, the use of telecommunication techniques was delayed until the technology had become capable of transmitting image data in reasonable time at reasonable cost. This happened during the 1980s, when digital telemedicine techniques evolved. The term 'telepathology' was introduced in 1986, when it was a topic in *Human Pathology*<sup>2</sup>. The potential of the technology presented to the world's pathologists seemed tremendous. But those who saw an important new technique emerging turned out to be overoptimistic.

Since the mid-1980s telepathology has been an extensive playground for academic research. Several different approaches to telepathology have been made using different technological bases<sup>3</sup>. The best approach, however, remains a matter of opinion about what is the most suitable technology, its cost-effectiveness and diagnostic reliability. Nevertheless, proponents of all approaches seem convinced of the benefits to pathologists from telepathology<sup>2-7</sup>. But if pathologists could profit so much from using telemedicine, why are so few of them taking advantage of it? Why is it taking so long to become established? Will it ever be widely used?

There is much anecdotal information available concerning the future of these techniques<sup>8,9</sup>, but little quantitative data about the attitude of the users towards them on which to base policies in order to transfer telemedicine from academic institutions into routine practice.

Telepathology offers the possibility of communication with experts for advice about any diagnostic problem. This implies the need to establish a global telepathology network. Although the exchange of interesting cases between university departments in realtime itself would be desirable, the true potential of

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telepathology in diagnosis and education can be realized only by integrating partners of any level of expertise. This would require the integration of routine laboratories into the proposed network.

The evolution of telepathology in the last 10 years shows that something is seriously wrong with the present understanding of the concept<sup>9</sup>. If we believe in the benefits of worldwide expertise 'on line', it is necessary to find out more about the attitude of the potential partners in telepathology, as well as their level of knowledge and the major concerns about integrating telepathology into daily routine. This would allow the development of strategies for adapting telepathology to the real needs of the eventual users. The present study was carried out to address these questions.

## Methods

The members of the Austrian Society of Pathology were asked about their attitude towards telemedicine. At the time of the study there were 216 registered pathologists and 60–70 trainees in Austria. The Society had 256 members covering all aspects of pathology, from university departments (79) to hospital departments (122) to private laboratories (55). As practically all pathologists in Austria are members of the Austrian Society of Pathology, this sample can be regarded as representative for pathology in any central European country.

A set of closed questions was developed which in most cases could be answered by a simple yes/no decision or by assigning a number to a question on a scale given (1–5) (see tables). Closed, multiple-choice questions can be answered much more quickly than writing free-text answers, so that the return rate can be expected to be higher<sup>10</sup>. The questionnaire was distributed by post. It was in German. Completion of the questionnaire was voluntary.

The questions were in several categories: a number of questions collected personal data from participants and enquired about the status of computing and telecommunication technology in their laboratories (questions 1–9). Subsequent questions covered general aspects of telemedicine, including possible obstacles to the introduction of this technique into routine practice (questions 10–16, 24). Three questions were dedicated to special problems in telepathology (questions 17–19). The remaining questions concerned teleconferencing/telelearning (questions 20–23). Questions dealing with technological details were not included. The questionnaire could be completed in about 10 min.

An identification number on the return envelope allowed us to determine who had not returned the questionnaire. These persons were reminded twice by telephone to complete it. The questionnaire responses themselves were anonymous. Data were analysed using descriptive statistics.

## Results

### Respondents

The overall response rate was 46% (118 questionnaires). The response rate from pathologists in hospital departments was 58%, from university members was 48% and from private laboratories was 20%. The distribution of the return rates with respect to age, sex and skill level is shown in Table 1. Table 2 indicates where the respondents worked and Table 3 describes their working environment. Eighty-four per cent of the laboratories used computers and 73% of all laboratories used local area networks. Thirty-four per cent were linked with wide area networks. In addition to the conventional transmission of reports by mail or courier services, 81% of respondents transmitted their reports by fax and 29% by computer connections.

**Table 1** Respondents' characteristics with respect to age, sex and professional level

	No. (%) of subjects
<i>Age</i>	
<45 years	84 (71%)
>45 years	33 (28%)
No answer	1 (1%)
<i>Sex</i>	
Female	31 (26%)
Male	85 (72%)
No answer	2 (2%)
<i>Professional level</i>	
Resident	20 (17%)
Specialist	96 (81%)
No answer	2 (2%)

**Table 2** Respondents' place of work

	Main place of work	Additional place of work
Own practice	6 (5%)	13 (11%)
Joint practice	2 (2%)	0 (0%)
Public hospital	71 (60%)	2 (2%)
Private hospital	3 (3%)	2 (2%)
University hospital	33 (28%)	1 (1%)

**Table 3** Working environment of respondents

	Yes	No	Planned	Don't know	No answer
<i>Is your place of work equipped with:</i>					
More than one telephone line?	115 (98%)	2 (2%)	0 (0%)		1 (1%)
A fax?	112 (95%)	1 (1%)	2 (2%)		3 (3%)
An ISDN line?	22 (19%)	27 (23%)	11 (9%)	39 (33%)	19 (16%)
<i>Do you use computers?</i>	99 (84%)	4 (3%)	13 (11%)		2 (2%)
<i>If yes, do you use:</i>					
A CD-ROM drive?	47 (40%)	26 (22%)	11 (9%)		34 (29%)
A local area network (LAN)?	86 (73%)	2 (2%)	15 (13%)		15 (13%)
A wide area network (WAN)?	40 (34%)	22 (19%)	25 (21%)		31 (26%)
<i>What kind of data do you store:</i>					
Data concerning invoices?	62 (53%)	24 (20%)	14 (12%)		18 (15%)
Patients' data?	97 (82%)	4 (3%)	10 (9%)		7 (6%)
Test (e.g. laboratory) results?	90 (76%)	6 (5%)	13 (11%)		9 (8%)
Images/other data?	26 (22%)	52 (44%)	14 (12%)		26 (22%)
<i>How do you transmit results:</i>					
Mail?	96 (81%)	7 (6%)	0 (0%)		15 (13%)
Fax?	95 (81%)	8 (7%)	3 (3%)		12 (10%)
Messenger service?	76 (64%)	11 (9%)	0 (0%)		31 (26%)
Computer networks?	34 (29%)	24 (20%)	25 (21%)		35 (30%)

**Table 4** Opinions concerning potential difficulties in telemedicine\*

	1	2	3	4	5	No answer
Costs and reimbursement	33 (28%)	25 (21%)	32 (27%)	16 (14%)	7 (6%)	5 (4%)
Effort and time for consulted physicians	11 (9%)	31 (26%)	43 (36%)	24 (20%)	5 (4%)	4 (3%)
Data security	36 (31%)	26 (22%)	17 (14%)	17 (14%)	19 (16%)	3 (3%)
Questions of responsibility and liability	43 (36%)	36 (31%)	20 (17%)	10 (9%)	5 (4%)	4 (4%)
Poor image quality	22 (19%)	29 (25%)	31 (26%)	21 (18%)	10 (9%)	5 (4%)
Poor information about the patient	21 (18%)	19 (16%)	37 (31%)	22 (19%)	13 (11%)	6 (5%)

Other doubts were recorded by 10 subjects (9%).

\*1, very problematic, to 5, insignificant.

**Table 5** Opinions concerning potential benefits of telemedicine

	Enormous benefit	Some benefit	No benefit	No answer
Diagnostics: first opinion	26 (22%)	54 (46%)	34 (29%)	4 (4%)
Diagnostics: second opinion	86 (73%)	26 (22%)	3 (3%)	3 (3%)
Clinicopathological conferences/videoconferences	70 (59%)	38 (32%)	8 (7%)	2 (2%)
Education/teaching	82 (69%)	27 (23%)	6 (5%)	3 (3%)
Library services/on-line reference database	96 (81%)	17 (14%)	0 (0%)	5 (4%)

Note the high percentage of respondents affirming both the problems (Table 4) and the expected benefits (this table) of telemedicine. This can be regarded as the result of an ambivalent attitude.

## General aspects of telemedicine

The concerns with telemedicine judged problematic or very problematic were liability (67%), data security (53%), costs (49%) and image quality (43%). The full results are shown in Table 4.

Applications that could profit from telemedicine technology were thought to be (in descending order): reference databases (81%), expert consultation (73%), education/training (69%) and clinicopathological conferences (59%) (Table 5). Sixty-nine per cent of the respondents believed that the use of electronic media could save time and money in medicine, and while

27% of the pathologists believed that the quality of diagnoses could be improved by using telepathology, 60% did not expect a significant change in diagnostic quality.

## Telepathology system requirements

Making a primary diagnosis using telepathology was regarded as at least possible by 92% using remotely controlled microscopy. High-resolution still images were deemed suitable only by 19% of the respondents, even if the field of view could be pre-selected by the

pathologists themselves in lower (videoconferencing) quality. The requirements for expert consultation or for giving a second opinion were very similar to those thought to be necessary for making a primary diagnosis.

**Sampling**

Sampling of the microscopic fields of interest by others was not thought acceptable by 60%. In the case of frozen sections, 39% would not regard the surgeon doing the macroscopic sampling as acceptable. Technicians were not favoured by 68%. Macroscopic sampling controlled by the pathologist using a video-camera was viewed sceptically by 39%. Full results are shown in Tables 6 and 7.

**Teleconferencing**

Clinicopathological conferences were regarded as beneficial by providing easier access to international experts (77%), facilitating interdisciplinary collaboration (70%) and saving time and costs (41%) (Table 8).

**Telelearning**

Telelearning was thought to save time and costs (60%) and facilitate training at work (81%) and at home (67%). Replacing classical methods of education seemed impossible for more than 85% of the respondents. Only a minority thought that telecommunication technology was suitable to

replace slide seminars (8%) or books (5%). Full results are shown in Table 8.

**Discussion**

The present study documents the point of view of pathologists with regard to telemedicine for the first time.

The overall response rate to the survey was 46% indicating a high interest in the topic: the expected response rate of a questionnaire of this type is about 30%<sup>10</sup>. At first glance it seems that the pathologists of central Europe are very open to the introduction of telecommunication techniques in pathology. Telemedicine is believed to offer savings in time and money, and telepathology is thought to be useful in any of the applications proposed (question 16). In contrast to this optimism, a deep though unfocused scepticism was expressed in the responses to questions dealing with transferring these techniques into routine work (question 15). The reason for this is the lack of information for the respondents. For example, questions of liability have been clarified for various legal systems<sup>11,12</sup>. Encryption has solved problems of data security. Image quality in telemedicine is no longer an issue and has been shown to be sufficient in various reports<sup>2-7,13-15</sup>. Nevertheless, all these topics were judged problematic in the context of

**Table 6** Implementation of telepathology into routine diagnosis

	Possible/ acceptable	Conceivable	Not possible	No answer
<i>Under which circumstances would you make a diagnosis by telemedicine:</i>				
Histological examination with a remote-control microscope (all functions of the microscope remotely controlled)?	52 (44%)	56 (48%)	7 (6%)	3 (3%)
Histological examination using high-quality live images with operation of the microscope by other persons?	18 (15%)	62 (53%)	34 (29%)	4 (3%)
Examination of self-chosen, high-quality still images?	22 (19%)	70 (59%)	22 (19%)	4 (3%)
Examination of still images chosen by specially trained persons?	10 (9%)	32 (27%)	71 (60%)	5 (4%)
<i>In examining frozen sections, which scenario is conceivable:</i>				
Macroscopy by a (specially trained) surgeon?	14 (12%)	54 (46%)	46 (39%)	4 (3%)
Macroscopy by a specially trained technician?	4 (3%)	29 (25%)	80 (68%)	5 (4%)
Macroscopy by examination via screen?	14 (12%)	58 (49%)	46 (39%)	0 (0%)

**Table 7** Factors deemed important for pathologists to give a second opinion (consultation) via telemedicine

	Very important	Sufficient	Insufficient	No answer
High-quality live images	98 (83%)	9 (8%)	6 (5%)	5 (4%)
Examination of self-chosen, high-quality still images	75 (64%)	28 (24%)	8 (7%)	7 (6%)
Examination of still images chosen by specially trained persons	14 (12%)	22 (19%)	74 (63%)	8 (7%)

**Table 8** Benefits expected of teleconferencing and telelearning

	Yes	No	Don't know	No answer
<i>Do you think that the use of modern telecommunication systems for clinicopathological conferences will:</i>				
Save costs and time?	48 (41%)	33 (28%)	33 (28%)	4 (3%)
Facilitate the integration of international experts?	91 (77%)	10 (9%)	14 (12%)	3 (3%)
Improve patient treatment?	56 (48%)	28 (24%)	31 (26%)	3 (3%)
Facilitate cooperation between different subspecialties?	83 (70%)	19 (16%)	15 (13%)	1 (1%)
Reduce personal contact between colleagues?	37 (31%)	62 (53%)	17 (14%)	2 (2%)
Lead to further mechanization in medicine?	18 (15%)	73 (62%)	25 (21%)	2 (2%)
Be of no use for the daily routine in medicine?	28 (24%)	65 (55%)	22 (19%)	3 (3%)
<i>Do you think that interactive education and teaching using modern video and communication technologies will:</i>				
Save costs and time?	71 (60%)	26 (22%)	20 (17%)	1 (1%)
Facilitate education at the place of work?	95 (81%)	14 (12%)	8 (7%)	1 (1%)
Facilitate education at home?	79 (67%)	23 (20%)	13 (11%)	3 (3%)
Facilitate the expansion of special knowledge?	93 (79%)	10 (9%)	13 (11%)	2 (2%)
Reduce the exchange of experiences by discussion with colleagues?	32 (27%)	62 (53%)	21 (18%)	3 (3%)
<i>Do you think that interactive education will:</i>				
Improve the possibilities of continuing education?	91 (77%)	12 (10%)	13 (11%)	2 (2%)
Replace ordinary slide seminars?	9 (8%)	101 (86%)	5 (4%)	3 (3%)
Replace books?	6 (5%)	106 (90%)	3 (3%)	3 (3%)
<i>Do you think that library services/on-line reference databases will:</i>				
Facilitate working from home?	79 (67%)	20 (17%)	16 (14%)	3 (3%)
Facilitate access to expert knowledge/images?	100 (85%)	2 (2%)	13 (11%)	3 (3%)
Facilitate differential diagnosis by offering cross-references?	84 (71%)	10 (9%)	23 (20%)	1 (1%)
Offer actual information at any time?	98 (83%)	4 (3%)	14 (12%)	2 (2%)
Offer no advantage over conventional textbooks?	8 (7%)	78 (66%)	30 (25%)	2 (2%)

Note the high acceptance of using this technology in clinicopathological conferences and the benefits expected from telelearning and teletraining. Telelearning was not judged superior to conventional textbooks and can therefore be regarded as an additional tool for education.

telepathology. Obviously, the flow of information from experts to potential users has been insufficient.

Low-specification technology is not acceptable in telepathology. In contrast to the experts' discussions about the best technical solution, the potential users have already reached a consensus concerning the best way to practise telepathology. Pathologists do not want to change their traditional method of examining a specimen. This is only possible in telepathology using a remotely controlled microscope. The only difference to classical microscopy which has been accepted is to look at a screen instead of looking into a microscope. Such a system has been operative in Norway for frozen-section services for several years<sup>3</sup>. Any change in the way of looking at a slide (e.g. live video with the microscope controlled by others) is regarded more sceptically. High-resolution still-image systems are not favoured by the vast majority of pathologists, although this technique has repeatedly been proved to be suitable for teliagnosis<sup>4,6,16,17</sup>. However, imitation of traditional practice by means of telepathology needs substantial technical capabilities, including a large bandwidth for data transmission, which has not been affordable until recently.

Correct macroscopic sampling is required for pathological diagnosis. The example of a distant frozen-section service shows that pathologists are afraid of sampling errors made by others and they therefore do

not want to share the responsibility of sampling. Specially trained technicians, nor even specially trained surgeons, would not be acceptable to most pathologists for macroscopic sampling. Looking at the sample on the monitor and guiding a person at the remote end to do the cutting of the specimen was judged superior to sampling by a surgeon. This is surprising, as the manual examination of a specimen by the pathologist is thought to be very important to obtain information about the consistency of the material. Changes in the consistency of tissues usually provide important information about the presence of subtle changes in tissues. The techniques of telesurgery may help solve this problem<sup>18</sup>. Again, the need for technical resources and transmission bandwidth would rise dramatically if this was to be adopted in telepathology.

Teleconferencing as well as telelearning seems more likely to be implemented in the near future.

The benefits of videoconferencing are obvious in terms of facilitating the integration of international experts and interdisciplinary collaboration. Teleconferencing using ISDN-based equipment is much cheaper than the solutions proposed for live, remote-controlled microscopy and could therefore become widespread within a shorter time<sup>19</sup>. Telelearning is seen as an additional possibility for education and training at work and at home.

Telepathology will be implemented when technology adapts to all the requirements of the pathologists and when experts have successfully spread their expertise concerning all topics in the field of telepathology among the potential users. However, the time for this second birth of telepathology is not easy to predict.

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## References

- 1 Einthoven W. Le télécardiogramme. *Archives Internationales de Physiologie* 1906;**4**:132-64
- 2 Weinstein RS. Prospects for telepathology. *Human Pathology* 1986;**17**:433-4
- 3 Weinstein RS. Static image telepathology in perspective. *Human Pathology* 1996;**27**:99-101
- 4 Oberholzer M, Fischer HR, Christen H, *et al.* Telepathology: frozen section diagnosis at a distance. *Virchows Archive* 1995;**426**:3-9
- 5 Ito H, Adachi H, Taniyama K, Fukuda Y, Dohi K. Telepathology is available for transplantation-pathology: experience in Japan using an integrated, low-cost, and high-quality system. *Modern Pathology* 1994;**7**:801-5
- 6 Nordrum I, Engum B, Rinde E, *et al.* Remote frozen section service: a telepathology project in northern Norway. *Human Pathology* 1991;**22**:514-18
- 7 Wynn Jones J, Lewis L, Groves-Phillips S. Telemedicine: if it is the answer, then what are the questions? *British Journal of Hospital Medicine* 1996;**55**:4-5
- 8 Harris BA Jr. Telemedicine: a glance into the future. *Mayo Clinic Proceedings* 1994;**69**:1212
- 9 Weinstein RS, Bhattachryya AK, Graham AR, Davis JR. Telepathology: a ten year progress report. *Human Pathology* 1996;**28**:1-7
- 10 Oesterreichisches Statistisches Zentralamt (Austrian Central Statistics Office). *Handbook of the Austrian Central Statistics Office* 1990. Vienna: OZ, 1990: 250 ff.
- 11 Allaert FA, Dusserre L. Legal requirements for tele-assistance and tele-medicine. *Medical Informatics* 1995;**8**:1593-5
- 12 Mairinger T, Netzer TT, Gschwendtner A, Markl C. The legal situation of telemedicine in Austria. *Journal of Telemedicine and Telecare* 1997;**3**:154-7
- 13 Doolittle MH, Doolittle KW, Winkelman Z, Weinberg DS. Color images in telepathology: how many colors do we need? *Human Pathology* 1997;**28**:36-41
- 14 Perednia DA, Allen A. Telemedicine technology and clinical applications. *Journal of the American Medical Association* 1995;**273**:483-8
- 15 Weinberg DS, Allaert FA, Dusserre P, *et al.* Telepathology diagnosis by means of digital still images: an international validation study. *Human Pathology* 1996;**27**:111-18
- 16 Eusebi V, Foschini L, Erde S, Rosai J. Transcontinental results in surgical pathology via the Internet. *Human Pathology* 1997;**28**:13-16
- 17 Weinstein MH, Epstein JI. Telepathology diagnosis of prostate needle biopsies. *Human Pathology* 1997;**28**:22-9
- 18 Satava RM, Simon IB. Teleoperation, telerobotics, and telepresence in surgery. *Endoscopic Surgery and Allied Technologies* 1993;**1**:151-3
- 19 Jameson DG, O'Hanlon P, Buckton S, Hobsley M. Broadband telemedicine: teaching on the information superhighway. *Journal of Telemedicine and Telecare* 1995;**1**:111-16